3.1 EARTH

3.1.1 Existing Conditions

Location and Physiography

The project site, which includes the footprint of the cogeneration facility, the refinery interface, the transmission system, Custer/Intalco Transmission Line No. 2, and other project components, is located in western Whatcom County, Washington. The Strait of Georgia is located west of the site and borders the western edge of Whatcom County. The site is located at the extreme northern end of the Puget Lowland physiographic province near where the lowland meets the southern end of the Georgia Lowland in British Columbia. Both lowlands occupy a north-south trending structural trough bordered by the Cascade and Coast Range mountains on the east and by the Olympic Mountains and Vancouver Island on the west. The Strait of Juan de Fuca separates the Olympic Mountains and Vancouver Island and connects the Strait of Georgia with the Pacific Ocean.

The project site is located on a glaciated upland. The Mountain View upland is bordered by the Strait of Georgia to the west; the Lummi Peninsula, Chuckanut Mountain, and Lookout Mountain to the south; and the Cascade Mountain foothills to the east. The upland extends northward into Canada where it terminates at the Coast Range Mountains at Vancouver. The upland is relatively flat with gently rolling hills bisected by small stream valleys tributary to major rivers or to the Strait of Georgia. Major rivers include the Nooksack, which discharges into the Strait of Georgia about 15 miles south of the site, and the Fraser, which empties into the Strait of Georgia at Vancouver about 25 miles to the north. Geologic, soils, topographic, and seismic conditions are fairly uniform over the project site.

Generalized Geologic History

It is widely held that approximately 200 million years ago, the breakup of the supercontinent, Pangaea, opened the Atlantic Ocean along a mid-ocean ridge and resulted in the westward movement of the North American continent and the subsidence of the oceanic crust beneath the western margin of the North American plate. Much of the north Cascade Range and Vancouver Island are composed of exotic terranes created during this time when subcontinents were accreted to the western margin of North America.

Approximately 57 million years ago at the beginning of the Eocene, vast alluvial floodplains covered the region with a lowland semitropical rain forest. This resulted in the deposition of the Chuckanut formation within a faulted, down-dropped basin. Subsequent displacement along the Straight Creek fault (approximately 60 miles to the west), uplift of the lowland basins, and changes in regional tectonics led to folding and thrusting of the Chuckanut formation. The sandstones, conglomerates, shales, and coal deposits of the Chuckanut formation are exposed in the Chuckanut Mountains along the southern margin of the Whatcom Basin immediately south of Bellingham (Easterbrook 1976).

The Puget Lowland has been glaciated numerous times during the Pleistocene epoch, with the last glacial advance occurring about 11,000 years ago; the Olympia interglaciation and the Fraser glaciation represent the two most important geologic units that occurred. The Fraser glaciation represents the most important in terms of the surficial deposits in the area of the proposed cogeneration project site. Successive advance and retreat of glaciers led to glaciomarine, marine, and related deposits in the coastal lowlands of southwestern British Columbia and northwestern Washington (Armstrong et al. 1965), followed by marine waters entering the area.

Topography

Topography of the proposed project is depicted in Figures 3.1-1 and 3.1-2. The proposed cogeneration facility is situated at an elevation of approximately 120 feet above mean sea level (MSL). The adjoining refinery is at an elevation of approximately 100 feet above MSL. As shown in the figures, there is a gentle downward slope (0.5% to 1%) toward the northwest. Terrell Creek is adjacent to the Applicant's habitat enhancement area north of the cogeneration facility. The creek runs through a shallow, narrow depression, which is 10 to 15 feet lower in elevation than the surrounding area.

The transmission system's interconnection elevation ranges from approximately 160 to 120 feet above MSL. The Custer/Intalco Transmission Line No. 2 ranges in elevation over its nearly 5-mile length from approximately 60 feet above MSL at the Custer substation to a high point of approximately 270 feet near the middle of the line and returns to approximately 200 feet above MSL at Intalco. The Alcoa Intalco Works is at an elevation of approximately 200 feet above MSL.

Regional Geology

The upland is underlain by unconsolidated glacial drift, including layers of till, glaciomarine drift, outwash sand and gravel, and fine-grained glaciolacustrine sediments. Drift thickness may reach several hundred feet. Recent sand and silt deposited as alluvium are associated with the Nooksack River. The drift is underlain by Eocene Chuckanut sandstone consisting primarily of thin-to-medium bedded sandstone with occasional layers of conglomerate, siltstone, shale, and coal. The coal beds extend beneath Bellingham Bay where they were extensively mined from the mid-1800s through the 1930s. The sandstone has been substantially folded and faulted and usually dips steeply where exposed. The sandstone is underlain by the Late Jurassic Darrington phyllite, a dark black, highly fractured micaceous metamorphic rock.

While the Chuckanut sandstone and Darrington phyllite have been deformed by folding and faulting, the overlying Pleistocene drift is relatively undeformed. The drift is too young to have experienced deformational forces over significant lengths of geologic time.

Project Area Geology

Figure 3.1-3 is a generalized geologic map of the project site and surrounding area. The site is underlain by glacial drift. The drift is comprised of the following deposits described in order from youngest to oldest:

Figure 3.1-1: Project Site Topography North of Grandview Road

Figure 3.1-2: Project Site Topography South of Grandview Road

Figure 3.1-3: Geologic Map

Quaternary

Glacial Outwash - Very limited thin deposits of sand and gravel occur at the land surface and overlie Bellingham drift. The sand and gravel are loosely consolidated and are well sorted to silty. This deposit is interpreted to be glaciofluvially reworked sediment from the Bellingham glaciomarine drift (Easterbrook 1976). The presence of this sand and gravel at the project site is unknown, but if present, it is not expected to be extensive. The sand and gravel are quite permeable and transmit water readily.

Bellingham Glaciomarine Drift – This deposit consists of a gray, nonsorted, and nonstratified pebbly sandy silt and pebbly clay. Published data suggest that the Bellingham drift is about 80 feet thick below the project site. The drift is generally firm to dense and may contain marine invertebrate fossils. Permeability is low and where exposed at land surface, the drift will pond water in closed topographic depressions. It was formed as sediment trapped in melting glacial ice floating in seawater accumulated on the sea bed. Bellingham drift covers the entire project site up to a thickness of 80 feet.

Deming sand – The sand is brown, stratified, well-sorted, and medium-to-coarse grained with some layers of silt, clay, and gravel. The sand is 30 to 40 feet thick below the project site and is generally dense. It is permeable and acts as an aquifer, though it appears to be discontinuous or is pinched out to the east and northeast of the project site.

Undifferentiated sedimentary deposits - This is a group of unconsolidated deposits that are not individually identified or distinguishable on project area well logs. The deposits may include the Kulshan glaciomarine drift, Vashon till, Esperance sand, and other glacial and nonglacial sediments underlying Bellingham drift. The thickness and consistency of these deposits vary substantially; however, in general, consistencies tend to be denser than those of the overlying deposits. Granular sediments have higher permeabilities than finer-grained sediments.

Pre-Quaternary

Undifferentiated sedimentary rock - The unconsolidated deposits are likely underlain by bedrock of the Chuckanut sandstone. These rocks were encountered at 210 and 256 feet below ground to the north and northeast of the project site.

Surficial Soils

Soil types in the project vicinity are shown in Figure 3.1-4 (Goldin 1992). These soil types are described below.

12 - Birch Bay silt loam (0 to 3% slopes) encompasses the northwestern portion of the project site. This deep, moderately well-drained soil is reworked glaciomarine drift material. Permeability is moderate in the upper part, very rapid in the sandy upper part of the substratum, and slow in the loamy lower part. Runoff is very slow and there is little or no hazard of erosion (Goldin 1992).

Figure 3.1-4:	Soil Types

80 – Kickerville silt loam (0 to 3% slopes) is found on a low hill in the northeast section of the project site north of Grandview Road. This deep, well-drained soil is found on outwash terraces. Permeability is moderate in the upper part and little or very rapid in the substratum. Runoff is very slow and there is no hazard of erosion (Goldin 1992).

93 – Labounty silt loam (0 to 2% slopes) encompasses the eastern portion of the transmission system intertie. This deep, poorly drained soil is found on reworked glaciomarine drift material. Permeability is slow. Runoff is very slow, and surface ponding may occur during the winter and spring. There is little or no hazard of erosion (Goldin 1992).

94 – Labounty silt loam, drained, (0 to 2% slopes) is found north of the project site, north of Grandview Road. Its description is the same as 93 above, except it is artificially drained to permit fieldwork earlier in the spring and increase yields of perennial crops (Goldin 1992).

171 – Urban land is found west and southwest of the project site. It consists of areas covered by streets, buildings, parking lots, and other structures that obscure the ground so that identification of the soil type is not feasible (Goldin 1992).

184 – Whitehorn silt loam (0 to 2% slopes) encompasses most of the project site. This deep, poorly drained soil occurs in depressions on glaciomarine drift plains. Permeability is moderately slow. Runoff is very slow, and there is little or no hazard of erosion (Goldin 1992).

The erosion factor K (potential for erosion) for soils at the project site (Birch Bay – Whitehorn) ranges from 0.10 to 0.49 (low to high). The risk of erosion of undisturbed soils in the vicinity of the site is low because of the relatively flat slopes and vegetative cover.

Geologic and Natural Hazards

Geologic and natural hazards that could affect the cogeneration facility and associated infrastructure include:

- seismic hazards,
- erosion hazards as a result of flooding,
- volcanic hazards, and
- tsunami hazards.

Seismic Hazards

The site is located in seismically active western Washington. Two of the earth’s crustal plates collide offshore from Washington’s coast. The Juan de Fuca oceanic plate moves eastward and collides with the North American continental plate, which is moving relatively westward. Because the continental plate is less dense than the oceanic plate, the oceanic plate dives and is subducted beneath the continental plate. The stresses developed as the two plates collide release energy in the form of earthquakes. Earthquakes associated with plate collisions are generally deep (greater than 15 miles below ground surface), often at around 40 miles beneath the land surface. Some of the energy released by these earthquakes is absorbed as it passes through the earth's crust, reducing impacts at the surface.

The plate collision induces stresses in the bedrock of the continental crust. If induced stress is sufficient, the crustal rocks will fracture, creating faults. Movement along these faults releases energy causing shallow earthquakes at less than 15 miles beneath the land surface. Two faults are recognized in northwestern Washington. The Devils Mountain Fault is located in the Cascade Mountain foothills and extends northwesterly and westerly to northern Whidbey Island. The Vedder Mountain Fault runs northeast-southwest just south of Sumas and Everson, Washington. The fault is projected to extend to the Lummi Peninsula. A third fault, the Sumas, is hypothesized to extend parallel to the Vedder Mountain fault just north of Sumas. Direct association of earthquakes with these faults is uncertain. Historical earthquakes are listed in Table 3.1-1.

Table 3.1-1: Historical Western Washington Earthquakes with a Magnitude 5.0 or Greater

Year	Location	Magnitude	Depth
1909	Friday Harbor	6.0	deep
1932	Granite Falls	5.7	shallow
1949	Olympia	7.1	deep
1965	Tacoma	6.5	deep
1976	West of Friday Harbor	5.1	deep
1990	Deming	5.0	shallow
1995	Tacoma	5.0	deep
1996	Duvall	5.6	shallow
2001	Olympia	6.8	deep

Western Washington is listed as being in a Seismic Zone 3 in the Uniform Building Code. Seismic Zone 3 areas require a certain level of design to avoid damage from earthquakes that is not required in Seismic Zones 1 and 2. Earthquakes can damage structures and utilities in several ways:

- Ground Acceleration – The initial energy wave felt during an earthquake compresses the ground as it moves. The compression can move the ground surface laterally such that the ground surface accelerates quickly beneath structures on the land surface. This acceleration can severely damage structures. Seismic Zone 3 areas can experience ground acceleration between 0.2 to 0.3 times the acceleration of gravity
- Ground Shaking – Complex energy waves follow the compression wave from an earthquake. The complex waves can impart a great deal of energy into the ground and cause severe shaking in structures. The closer a site is to the source of the earthquake, the greater the ground shaking. The degree of ground shaking is also related to the earthquake's magnitude and the soils underlying the site. Unconsolidated soils tend to slow earthquake energy waves, thereby increasing their amplitude, which in turn increases ground shaking. Earthquake waves traveling through bedrock move at a much greater velocity and have smaller amplitudes resulting in less ground motion.

- Ground Surface Rupture – If ground shaking is excessive, the ground surface may rupture, potentially damaging structures. Ground surface ruptures are neither areally extensive nor common during western Washington earthquakes.
- Differential Settlement – Strong ground motion may compress unconsolidated soils. Loads induced by structures can enhance this process. More loosely consolidated soils may settle greater amounts, thereby removing foundation support and damaging overlying structures. Underground utilities can also be damaged in this manner.
- Landslides – Steep slopes where unstable geologic conditions exist are prone to landslides. Triggering mechanisms, such as earthquakes, can initiate both large and small landslides in such areas. Some of the largest and most spectacular landslides in western Washington were the result of earthquakes.
- Soil Liquefaction – Certain soil types with a distinct combination of physical properties and moisture content are susceptible to liquefaction. In this process, the friction between the soil grains that binds the soil cohesively is overcome by the pore pressure of the water in the soil pore spaces. This results in the soil behaving like a viscous liquid. Structures located on such soils can settle substantially and suffer severe damage.

Potential impacts to the site from these hazards are addressed in the following sections.

Ground Acceleration

Compliance with design criteria outlined for Seismic Zone 3 in the Uniform Building Code would protect against damage from ground acceleration.

Ground Shaking

A useful way to describe earthquake shaking for engineering purposes is in terms of peak ground acceleration (PGA). This measure provides useful information about the forces that might be applied to engineered structures during earthquake shaking.

The U.S. Geological Survey (USGS) National Seismic Hazard Mapping Project has completed a probability seismic hazard assessment for the contiguous U.S. USGS estimates probable seismic hazards by considering the probability of occurrence of all earthquakes and ground motion associated with these earthquakes and calculating the probability that a certain level of shaking would be exceeded in a chosen time period. The 10% probability of exceeding a mean PGA value in a 50-year period is a common measure used in engineering studies. (This probability also can be expressed as a 90% probability that ground motion will not occur in 50 years.) This is equivalent to the mean ground motion with a return period of 475 years.

The proposed project site is located in an area of moderate earthquake hazard. A PGA of 0.23 (expressed in units of gravity) has a 10% chance of being exceeded in the next 50 years. Strong shaking of 0.54 gravity has a 1% chance of being exceeded in 50 years. These levels of earthquake shaking are estimated for weak rock sites. The character (frequency and duration) of earthquake shaking at the proposed project site would be different than that calculated by the USGS models because the proposed project site is underlain by more than 200 feet of sediment. Sediment layers would modify the character of earthquake ground motion.

The cogeneration facility is underlain by more than 200 feet of Quaternary-age glaciofluvial and glaciomarine deposits. The upper 100 feet of these deposits is typically soft to medium stiff glaciomarine drift to about 50 feet below ground. Below about 50 feet the drift is very stiff to hard.

The upper 50 feet of sediment is expected to have a low average "shear wave velocity." Average shear wave velocity in the upper 100 feet of soil determines earthquake response, and shear wave velocity is used to characterize the soil profile type in the 1997 UBC. Low average shear wave velocity deposits can filter out short-term ground motion and amplify the longer duration ground motion. Amplification during longer duration motion is potentially more damaging to tall structures and requires consideration during design. The magnitude of site amplification would depend primarily on the frequency, content, and intensity of the ground motion and local soil conditions. Topographic amplification of earthquake shaking is not expected at the project site because of the low topographic relief. In addition, the impact of ground shaking on underground utilities is expected to be minimal.

Landsliding

Earthquake-triggered landslides are not a potential hazard at the proposed project site because there are no steep slopes in the area.

Soil Liquefaction

Preliminary analysis of subsurface soils close to the project site indicates that soils lack the physical properties that lead to liquefaction. Without these properties being present, the potential for liquefaction at the project site is low.

Ground Surface Rupture

No active faults are known to exist beneath the project site; however, the Vedder Mountain and Sumas faults extend across Whatcom County in a southwesterly direction (see Figure 3.1-5). Analysis indicates that the potential hazard from surface faulting at the project site is low.

Differential Settlement

Site surficial soils have the potential for settlement based on their consistency and moisture content. The foundations for various structures and equipment, particularly vibrating equipment, should be designed to compensate for potential differential settlement.

<u>Erosion Hazards as a Result of Flooding</u>

The proposed cogeneration facility and associated structural components are located outside any 5-, 100-, or 500-year floodplains, as designated by the Federal Emergency Management Agency (FEMA). Site soils are fairly impervious (clay/silt), and topography is relatively flat. Also, vegetation is well established. Based on these factors, there is a low risk for erosion from flooding.

Figure 3.1-5: Seismotectonic Map of Northwest Washington and Southwest British Columbia

Volcanic Hazards

Five major composite volcanoes (or stratovolcanoes) are located in the state of Washington, all of which are part of the Cascade Range, a volcanic arc that stretches from southwestern British Columbia to northern California. These five volcanoes are Mount Baker, Glacier Peak, Mount Rainier, Mount St. Helens, and Mount Adams. All Washington volcanoes except Mount Adams have erupted within the last 250 years (Pringle 1994).

Of the five Washington volcanoes, only Mount Baker, and to a far lesser degree Glacier Peak, has any potential to affect the proposed project. Mount Baker is approximately 45 miles to the east and Glacier Peak is approximately 100 miles southeast of the project site.

In the case of a volcanic eruption, tephra (ash) deposition would be the biggest concern at the proposed project site; lava and debris flow would not be a concern because of the distance of Mount Baker and other Cascade volcanoes from the project site. The annual probability for the deposition of 0.39 inch or more of tephra at the project site from any Cascade volcano is 0.02%. The annual probability for the deposition of 3.9 inches or more of tephra at the project site from any Cascade volcano is less than 0.01%. Mount Baker has not historically produced large amounts of tephra and probably will not do so in the future (Gardner et al. 1995).

Tsunami

The vulnerability of the proposed project site to tsunamis that have been historically recorded or interpreted from the geologic record is very low. The site is at an elevation of 120 feet above MSL and is 2 miles from the Strait of Georgia. Sea cliffs ranging from 60 to 100 feet high protect most of the shoreline along the Strait of Georgia closest to the project site.

The shoreline near the project site is generally protected from tsunamis generated from distant trans-Pacific sources or Cascadia subduction zone seismic events by the relatively narrow confines of the Strait of Juan de Fuca and Strait of Georgia, and the buffer of the San Juan and Gulf islands. Similar protection is afforded from tsunamis generated from a large seismic event along the Seattle fault to the south. More commonly, a tsunami could be generated from a local earthquake disturbing the sea floor or by slumping along the front of the Nooksack delta (Easterbrook 1973). Such a tsunami could have severe local shoreline impacts, but is not expected to affect the proposed project.

3.1.2 Impacts of the Proposed Action

Construction

Cogeneration Facility

Excavation and Fill Materials

The existing terrain at the cogeneration facility and refinery interface area is relatively flat. Therefore, extensive grading of the site will not be required. It is anticipated that some unsuitable materials may require removal and that some imported fill of suitable quality will be needed for replacement, site preparation, and backfill. The imported fill, sand, and aggregate gravel would be obtained from local sources within Whatcom County. Site grading would use onsite fill to the extent possible to reduce the need for imported fill. Acquisition of fill material and sand and gravel would be the responsibility of the construction contractor.

Construction bulk materials including soil, sand, and gravel would be supplied locally from existing permitted sources and quarries. The total quantity of imported fill material is estimated to be approximately 126,000 cubic yards (75,600 tons). This quantity includes pavement base course material for the plant roadway and parking area and gravel surfacing material for the switchyard and power block areas. Impacts on the local sources and quarries of bulk construction materials will be consistent with those types of extractive land uses within the limitations of the permit requirements for these facilities. Specific sources had not been identified at the time of Draft EIS preparation. However, total gravel resources in Whatcom County that have been permitted for extraction represent 55.2 million tons. The permitted, active mines in Whatcom County are depicted in Figure 3.1-6. Based on estimates for the cogeneration project, approximately 27,000 tons of gravel would be required. Therefore, existing permitted sources of gravel (and fill material) would likely not be significantly impacted by construction of the project.

Undesirable site soils (with respect to engineering properties) would be removed and disposed of at an approved offsite location. Specific disposal locations would be determined during final project design and would be approved according to the requirements of a Whatcom County Clearing and Grading Permit for the project.

Soil Contamination

A very low potential exists for encountering contaminated soil within the proposed project site. Based on a review of historic aerial photographs and interviews with long-time BP employees, project areas were used for agriculture before the refinery was built and therefore are not expected to be sources of hazardous materials.

There is a potential for impacts on site soils through accidental spills of construction chemicals or through fuel and lubricant leaks from construction equipment. This issue is discussed in greater detail in Section 3.4 Water Quality and Section 3.16 Health and Safety. Effective implementation of the Stormwater Pollution Prevention (SWPP) plan and Spill Prevention Control and Countermeasures (SPCC) plan would limit the extent of soil contamination.

Topographic Modifications

No significant topographic modifications would be required to prepare any of the project sites because slopes range from only 0.5% to 1% (see Figures 3.1-1 and 3.1-2). Site grading would include cutting and filling with slopes directing stormwater drainage toward collection structures. Some unsuitable onsite materials would require removal, and some imported fill of suitable quality would be needed for replacement, site preparation, and backfill. This fill material would have minimal impacts on existing topography.

Figure 3.1-6: Permitted, Active Surface Mines in Whatcom County

Any clearing and grading activities would be accomplished using construction machinery such as excavators and bulldozers. Blasting to modify topography is not anticipated.

Erosion

Existing slopes range from 0.5% to 1%, with minimal potential for significant erosion. The potential for erosion would be further reduced by using the Best Management Practices (BMPs) described below in Section 3.1.5. Site grading and stockpiling would expose soils and would increase the potential for erosion. However, exposed and stockpiled soil would be controlled by the procedures and mitigation measures described below in Section 3.1.5.

<u>Refinery Interface</u>

Potential impacts from excavation, filling, and soil contamination described for the refinery interface components are similar to those described for the cogeneration facility construction. A greater potential exists for contacting contaminated soils during excavation activities on the refinery site because of industrial practices that have occurred there since the early 1970s. Topographic modifications and erosion hazards would be similar to those described for construction at the cogeneration facility site.

<u>Transmission System</u>

The access/maintenance roads leading to the transmission line corridor, as well as the construction access and maintenance road along the corridor and three of the four transmission tower pads, were previously graded under an existing Section 404 Permit. One additional 50-foot by 50-foot pad would be graded adjacent to the existing Custer/Intalco Transmission Line No. 2. Therefore, only very limited clearing and grading would be required to complete this project element.

<u>Custer/Intalco Transmission Line No. 2</u>

This specifics for this project element are still under development. One option being considered is replacing the existing single-circuit line with a double-circuit line. This would require placement of new towers. The location and number of these towers has not yet been determined. Also unknown is whether any new construction access roads would need to be established. These activities, if this option was chosen, may require clearing, grading, and topographic modification. There also could be exposed soil susceptible to erosion.

<u>Other Project Components</u>

Construction activities at Intalco would include excavation (presumably in a previously disturbed industrial area) to establish a 10-foot by 40-foot by 10-foot deep sump. Given that this would occur on land used for industrial purposes, there is a possibility of encountering contaminated soils. Topographic modifications would be minor and localized. There is an increased erosion risk while soils are exposed.

Construction of cogeneration facility access roads would require minor clearing and grading. Topographic modifications would be minimal because the existing topography is flat. There would be an increased erosion risk when soils are initially exposed until compaction and surfacing activities are completed.

Topographic modifications associated with the mitigation wetlands would involve filling some ditches on both compensatory wetland mitigation sites (CMA 1 and CMA 2) and construction of a level trench at about elevation 98 on CMA 2. Ditches in CMA 1 and CMA 2 would be filled primarily with material originally excavated to create them. For Laydown Area 4 and the northern approximately 273 feet of Laydown Area 2, fill would be removed at the end of project construction and wetland hydrologic conditions would be restored to the extent possible. Potential impacts to earth resources would be similar to those described for cogeneration facility construction.

Operation

Cogeneration Facility

Facility Operation and Maintenance

No significant impacts on soils or local topography are anticipated during the operation and maintenance of the cogeneration project. Additional fill or aggregate materials may be needed for repairs to roads and underground utilities, but the amounts would be minimal. The surface topography of the site is not expected to be altered after construction of the cogeneration facility.

Seismic Hazard

As discussed in Section 3.1.1, risk of a seismic event causing significant damage to the cogeneration facility and ancillary components is low because design criteria outlined for Seismic Zone 3 in the Uniform Building Code would be incorporated into the design. A large earthquake could affect operation of the cogeneration facility. However, it is unlikely that the impacts would be significant.

Volcanic Hazard

As discussed in Section 3.1.1, the greatest risk to the project from volcanic activity is from tephra (ash) fall. The probability of this impacting the cogeneration facility is low. Cogeneration facility operations would be suspended until tephra fall ceased and this material was cleaned up.

Refinery Interface

Impacts to earth resources and from natural hazards to components of the refinery interface are expected to be similar to those described for the cogeneration facility. It is possible that a large seismic event could damage pipelines. Damaged water pipelines could leak their contents until valves were closed. Ruptured gas lines could lead to fire and explosion. The probability of a large seismic event affecting pipe integrity is low due to design considerations.

Transmission System and Custer/Intalco Transmission Line No. 2

No impacts to earth resources are expected from operation of the transmission system or the Custer/Intalco Transmission Line No. 2. A large seismic event could damage transmission line towers and interrupt the flow of electricity.

Other Project Components

No impacts to earth resources are expected from operation of the water supply facilities at the Alcoa Intalco Works. A large seismic event could disrupt this facility.

3.1.3 Impacts of No Action

Under the No Action Alternative, most of the new facilities would not be constructed and no impacts on soils would occur. No construction impacts from the removal and handling of soil within the project site would occur. There would also be no change to the existing supply of fill materials from quarries in Whatcom County.

3.1.4 Secondary and Cumulative Impacts

No long-term secondary or cumulative impacts to earth resources from the proposed project or other reasonably foreseeable projects are expected. Some fill material would be supplied to the project from offsite sources and some material excavated from the site would need to be disposed of offsite. This would occur at approved or permitted locations.

Other construction projects in the area not associated with the cogeneration facility, such as the proposed Georgia Strait Crossing Project (GSX), also would likely have short-term impacts relating to clearing, excavation, and filling, and topographic modification. Under the proposed Georgia Strait Crossing project, installation of a pipeline along Grandview and Jackson roads would temporarily affect earth resources. Pipeline installation is scheduled to occur about the same time as construction of the proposed cogeneration project. Pipeline construction is expected to disturb surface soils within the 100-foot right-of-way (ROW) immediately north of Grandview Road and west of Jackson Road. The ROW would be cleared and the soil would be stockpiled within the ROW; a trench 6 to 10 feet deep and approximately 6 feet wide would be dug. These activities would affect the native soils within and adjacent to the pipeline ROW. It is anticipated that the topsoil would be restored and the area revegetated following pipeline installation. Thus, no long-term impacts on soils within the pipeline ROW or within the proposed cogeneration project boundaries are anticipated. BMPs used during installation of the pipeline would prevent/reduce impacts on other natural resources.

3.1.5 Mitigation Measures

Mitigation Proposed by the Applicant

<u>Construction</u>

Soil Contamination

In order to confirm the absence of contaminants, soils will be sampled and inspected before and during site clearing, grading, trenching, and other excavation activities. Despite these precautions, if suspect contaminated soil is encountered during trenching and other excavation activities, these activities will be stopped. Qualified personnel will respond to assess hazards and perform characterization. Treatment and/or disposal at an approved facility would depend on the type of contamination found.

A SWPP plan and SPCC plan would be developed and implemented for both construction and operation activities; these plans would outline strategies to prevent or minimize impacts on site soils from chemical spills and leaks of fuel and lubricants. The contents of the SWPP plan and SPCC plan are discussed in greater detail in Section 3.4 Water Quality.

Erosion Control Procedures

BMPs would be implemented during construction and operation for erosion control and prevention. BMPs would be described in a SWPP plan and Temporary Erosion and Sedimentation Control (TESC) plan developed prior to construction and operation. BMPs may include the installation of control structures such as silt fences/straw bales, sediment traps, and diversion ditches. Construction activities would be controlled to limit erosion. Graded areas would be smooth, compacted, free from irregular surface changes, and sloped to drain. Because the existing slopes range from 0.5% to 1%, extensive grading of the site would not be required. Disturbed areas would be surrounded with stabilized soil berms or sand bags to prevent erosion from affecting adjacent areas. Piles of excavated materials would be stabilized and protected using BMPs in accordance with a SWPP plan and TESC plan. Dust control and wind erosion would be controlled by spraying exposed soil with water.

Excavated materials of acceptable quality would be reused as much as possible. Excess materials would be disposed of at permitted fill sites or would be placed where they would not easily erode (i.e., not on slopes steeper than 3:1 unless compacted to the requirements of structural fill). Upon completion of construction, disturbed areas would be revegetated by seeding or hydroseeding. Seed mixes that are known to effectively stabilize erodible soils in northwestern Washington would be selected. Sprinkler systems may be used to sustain vegetation on bermed areas with high exposure to the erosive forces of wind.

Soil stockpiles would be seeded or covered with an emulsion and surrounded by silt fences and straw bales or sand bags, where necessary, to prevent excessive erosion by wind or rain.

Erosion control measures for construction, such as silt fencing, straw bales, and tarps, would be inspected and maintained periodically and after major storms as needed to ensure their continued effectiveness.

Stormwater runoff from the construction site would be collected and routed to a sediment control system. Sediment control measures, such as an oil-water separation system and detention ponds, would be sized for storm events ranging from 6-month, 24-hour up to the 100-year, 24-hour event. Details on the proposed stormwater and sediment control systems are provided in Section 3.4, Water Quality.

<u>Operation</u>

Seismic Hazards

The proposed cogeneration facility and associated infrastructure would be designed and built in accordance with applicable federal, state, and local building standards and codes specifically for power-generating facilities. The characteristics of soils at the proposed project site would be determined during the geotechnical analysis completed during detailed project design. If soils prove to be susceptible to induced amplification, the project design would incorporate protection measures against such seismic events.

Additional Recommended Mitigation Measures

<u>Volcanic Hazards</u>

In the event of tephra fall at the cogeneration facility, it is recommended that all activities at the facility be suspended until the tephra fall has ceased. All mechanical and electrical components and water supply containment structures should then be cleared of the volcanic ash before resuming operations.

3.1.6 Significant Unavoidable Adverse Impacts

No significant unavoidable adverse impacts on earth resources are identified. Project design as well as operation and maintenance planning would minimize potential risks from natural hazards such as seismic and volcanic events.